CLAIMS

1. In a planarizing process of a microelectronic substrate that includes first and second substances, the second substance being beneath a surface of the microelectronic substrate, a method of endpointing the planarizing process, comprising:

removing material from the microelectronic substrate to expose the second substance;

detecting the second substance while removing material from the microelectronic substrate; and

removing a sufficient amount of the second substance from the microelectronic substrate such that electrical characteristics of the microelectronic substrate are generally the same as those of the microelectronic substrate without the second substance.

2. The method of claim 1, further comprising implanting the second substance beneath the surface of the microelectronic substrate.

3. The method of claim 2 wherein atoms of the second substance have an electrical charge and implanting the second substance includes positioning the atoms of the second substance proximate to a like electrical charge to accelerate the atoms of the second substance toward the microelectronic substrate.

4. The method of claim 1, further comprising:

applying the second substance to a surface of the first substance; and

applying an additional amount of the first substance to the second substance.

5. The method of claim 4 wherein the act of applying the second substance includes depositing the second substance on the surface of the first substance while the second substance is a vapor.

6. The method of claim 1 wherein detecting the second substance includes detecting an atomic mass of atoms of the second substance.

7. The method of claim 1 wherein detecting the second substance includes detecting an intensity of light emitted by atoms of the second substance at a selected wavelength.

8. The method of claim 1 wherein detecting the second substance includes detecting an intensity of light emitted by atoms of the second substance while the second substance remains attached to the microelectronic substrate.

9. A method of planarizing a surface of a microelectronic substrate, comprising:

placing an endpointing substance in the substrate beneath the surface of the substrate solely for the purpose of endpointing the planarizing of the substrate;

abrasively removing material from the substrate at least to the level of the endpointing substance;

detecting when the endpointing substance is being abrasively removed along with the abrasive removal of the material from the substrate; and

terminating the abrasive removal of the material from the substrate responsive to detecting the abrasive removal of the endpointing substance.

10. The method of claim 9 wherein the abrasive removal of material from the substrate occurs in the presence of a planarizing fluid, and wherein the act of detecting the endpointing substance comprises analyzing the planarizing fluid to detect the presence of the endpointing substance in the planarizing fluid.

11. The method of claim 9 wherein detecting the endpointing substance includes detecting an atomic mass of atoms of the endpointing substance.

12. The method of claim 9 wherein detecting the endpointing substance includes detecting an intensity of light emitted by atoms of the endpointing substance at a selected wavelength.

13. The method of claim 9 wherein the abrasive removal of material from the substrate includes removing some of the endpointing substance.

14. The method of claim 9 wherein the abrasive removal of material from the substrate includes removing approximately all of the endpointing substance.

15. In a planarizing process of a microelectronic substrate that includes a first substance, a method of endpointing the planarizing process, comprising:

incorporating an amount of a second substance into the microelectronic substrate by implanting the second substance in the first substance and beneath a surface of the microelectronic substrate;

reducing a thickness of the microelectronic substrate by removing material from the microelectronic substrate to expose the second substance;

detecting the second substance by analyzing material of the microelectronic substrate; and

further reducing the thickness of the microelectronic substrate by removing approximately the entire amount of the second substance from the microelectronic substrate.

16. The method of claim 15 wherein atoms of the second substance have an electrical charge and implanting the second substance includes positioning the

atoms of the second substance proximate to a like electrical charge to accelerate the atoms of the second substance toward the microelectronic substrate.

17. The method of claim 15 wherein implanting the second substance includes forming a layer of the second substance within the microelectronic substrate.

18. The method of claim 17 wherein forming a layer includes forming a layer having a thickness in the range of approximately 100 Angstroms to approximately 500 Angstroms.

19. The method of claim 17 wherein forming a layer includes forming a layer centered at approximately 200 Angstroms beneath the surface of the microelectronic substrate.

20. The method of claim 17 wherein forming a layer includes forming a layer having a number of atoms of the second substance in the range of approximately 0.1% to approximately 0.001% of the number of atoms of the first substance.

21. The method of claim 15 wherein detecting the second substance includes detecting an atomic mass of atoms comprising the second substance.

22. The method of claim 15 wherein detecting the second substance includes comparing an atomic mass of atoms of the second substance with an atomic mass of atoms of the first substance.

23. The method of claim 15 wherein detecting the second substance includes detecting an intensity of light emitted by atoms of the second substance at a selected wavelength.

24. The method of claim 15 wherein detecting the second substance includes comparing an intensity of light emitted by atoms of the second substance to an intensity of light emitted by atoms of the first substance.

25. The method of claim 15 wherein detecting the second substance includes detecting an intensity of light emitted by atoms of the second substance while the second substance remains implanted in the microelectronic substrate.

26. The method of claim 15 wherein detecting the second substance includes detecting a layer of the second substance.

27. The method of claim 15 wherein the surface of the microelectronic substrate is a first surface, the microelectronic substrate having a second surface opposite the first surface, further wherein the first surface includes a first portion having a first height relative to the second surface and a second portion having a second height relative to the second surface different than the first height, further wherein the act of implanting the second substance includes implanting a first portion of the second substance at a first selected depth beneath the surface of the microelectronic substrate at the first portion and implanting a second portion of the second substance at a second selected depth beneath the surface of the microelectronic device at the second portion, the first and second depths being approximately equal.

28. The method of claim 27, further comprising ceasing to remove material from the microelectronic substrate after detecting the first and second portions of the second substance.

29. The method of claim 15, further comprising ceasing to remove material from the microelectronic substrate after detecting the second substance.

30. The method of claim 15 wherein the first substance includes at least one of tetraethylorthosilicate and borophosphate silicon glass, further comprising selecting the second substance from tungsten, aluminum and copper.

31. In a planarizing process of a microelectronic substrate that includes a first substance, a method of endpointing the planarizing process, comprising:

incorporating a second substance into the microelectronic substrate;

removing material from the microelectronic substrate to expose the second substance;

removing at least a portion of the second substance from the microelectronic substrate; and

detecting the portion of the second substance by determining an atomic mass of the second substance.

32. The method of claim 31 wherein incorporating the second substance includes implanting the second substance beneath a surface of the first substance.

33. The method of claim 32 wherein atoms of the second substance have an electrical charge and the act of implanting the second substance includes positioning the atoms of the second substance proximate to a like electrical charge to accelerate the atoms of the second substance toward the microelectronic substrate.

34. The method of claim 31 wherein incorporating the second substance includes:

applying the second substance to a surface of the first substance; and

applying an additional amount of the first substance to the second substance.

35. The method of claim 34 wherein the act of applying the second substance includes depositing the second substance on the surface of the first substance while the second substance is in vapor form.

36. The method of claim 31 wherein determining an atomic mass of the second substance includes determining the atomic mass of the second substance relative to an atomic mass of the first substance.

37. The method of claim 31 wherein removing material from the microelectronic substrate includes engaging a planarizing liquid with the microelectronic substrate and removing the second substance from the microelectronic substrate includes mixing a portion of the second substance with the planarizing liquid, further comprising vaporizing at least some of the planarizing liquid and the portion of the second substance in the planarizing liquid.

38. The method of claim 31 wherein detecting the portion of the second substance includes passing atoms of the second substance proximate to a magnetic field and determining a deflection of the atoms due to the magnetic field.

39. The method of claim 31 wherein the surface of the microelectronic substrate is a first surface, the microelectronic substrate having a second surface opposite the first surface, further wherein the first surface includes a first portion having a first height relative to the second surface and a second portion having a second height relative to the second surface different than the first height, further wherein the act of implanting the second substance includes implanting a first portion of the second substance at a first selected depth beneath the surface of the microelectronic substrate at the first portion and implanting a second portion of the second substance at a second selected depth beneath the surface of the microelectronic device at the second portion, the first and second depths being approximately equal.

40. The method of claim 39, further comprising ceasing to remove material from the microelectronic substrate after detecting the first and second portions of the second substance.

41. The method of claim 31, further comprising ceasing to remove material from the microelectronic substrate after detecting the second substance.

42. In a planarizing process of a microelectronic substrate that includes a first substance, a method of endpointing the planarizing process, comprising:

implanting a second substance beneath a surface of the microelectronic substrate;

removing material from the microelectronic substrate to expose the second substance;

removing at least a portion of the second substance; and

detecting light emitted by atoms of the second substance.

43. The method of claim 42 wherein the act of detecting light emitted by atoms of the second substance includes detecting an intensity of the light at a selected wavelength.

44. The method of claim 42, further comprising comparing an intensity of light emitted by atoms of the second substance to an intensity of light emitted by atoms of the first substance.

45. The method of claim 42, further comprising exciting atoms of the second substance.

46. The method of claim 42 wherein removing material from the microelectronic substrate includes exposing the microelectronic substrate to a

planarizing liquid and removing the second substance from the microelectronic substrate includes mixing a portion of the second substance with the planarizing liquid, further comprising vaporizing at least some of the planarizing liquid and the portion of the second substance in the planarizing liquid.

47. The method of claim 42 wherein atoms of the second substance have an electrical charge and implanting the second substance includes positioning the atoms of the second substance proximate to a like electrical charge to accelerate the atoms of the second substance toward the microelectronic substrate.

48. The method of claim 42 wherein the surface of the microelectronic substrate is a first surface, the microelectronic substrate having a second surface opposite the first surface, further wherein the first surface includes a first portion having a first height relative to the second surface and a second portion having a second height relative to the second surface different than the first height, further wherein the act of implanting the second substance includes implanting a first portion of the second substance at a first selected depth beneath the surface of the microelectronic substrate at the first portion and implanting a second portion of the second substance at a second selected depth beneath the surface of the microelectronic device at the second portion, the first and second depths being approximately equal.

49. The method of claim 48, further comprising removing the first and second portions of the second substance.

50. The method of claim 48, further comprising ceasing to remove material from the microelectronic substrate after detecting the first and second portions of the second substance.

51. The method of claim 42, further comprising ceasing to remove material from the microelectronic substrate after detecting the second substance.

52. In a planarizing process of a microelectronic substrate that includes a first substance, a method of endpointing the planarizing process, comprising:

implanting a second substance beneath a surface of the microelectronic substrate;

directing laser radiation toward the surface of the microelectronic substrate and exciting atoms impinged by the laser radiation

removing material from the microelectronic substrate to expose the second substance;

detecting the second substance by determining an intensity of light emitted by excited atoms of the second substance while the second substance is attached to the microelectronic substrate; and

removing a sufficient amount of the second substance from the microelectronic substrate such that electrical characteristics of the microelectronic substrate are generally the same as those of the microelectronic substrate without the second substance.

53. The method of claim 52, further comprising selecting a wavelength of the laser radiation to excite atoms of the first substance to a first selected level and excite atoms of the second substance to a second selected level, the second selected level being higher than the first selected level.

54. The method of claim 52 wherein the act of removing material from the microelectronic substrate includes exposing the microelectronic substrate to a planarizing liquid and the step of removing the second substance from the microelectronic substrate includes mixing a portion of the second substance with the planarizing liquid, further comprising vaporizing at least some of the planarizing liquid and the portion of the second substance in the planarizing liquid.

55. The method of claim 52 wherein atoms of the second substance have an electrical charge and implanting the second substance includes positioning the atoms of the second substance proximate to a like electrical charge to accelerate the atoms of the second substance toward the microelectronic substrate.

56. The method of claim 52 wherein the surface of the microelectronic substrate is a first surface, the microelectronic substrate having a second surface opposite the first surface, further wherein the first surface includes a first portion having a first height relative to the second surface and a second portion having a second height relative to the second surface different than the first height, further wherein the act of implanting the second substance includes implanting a first portion of the second substance at a first selected depth beneath the surface of the microelectronic substrate and implanting a second portion of the second substance at the first portion and at a second selected depth beneath the surface of the microelectronic device at the second portion, the first and second depths being approximately equal.

57. The method of claim 56, further comprising removing material from the first and second portions of the second substance.

58. The method of claim 56, further comprising ceasing to remove material from the microelectronic substrate after detecting the first and second portions of the second substance.

59. The method of claim 52, further comprising ceasing to remove material from the microelectronic substrate after detecting the second substance.

60. A microelectronic substrate, comprising:
a semiconductor material; and

an endpointing material positioned beneath a surface of the semiconductor material, the amount of endpointing material in the semiconductor material being such that electrical characteristics of the semiconductor material with the endpointing material positioned beneath the surface of the semiconductor material are generally the same as electrical properties of the semiconductor material without the endpointing material.

61. The substrate of claim 60 wherein the endpointing material includes a layer of endpointing material atoms located a selected distance beneath the surface of the semiconductor material.

62. The substrate of claim 60 wherein the semiconductor material includes silicon and the endpointing material is selected from tungsten, copper and aluminum.

63. The substrate of claim 60 wherein the semiconductor material is selected from tetraethylorthosilicate and borophosphate silicon glass and the endpointing material does not include silicon.

64. The substrate of claim 60 wherein the semiconductor material includes a first substance having a first atomic mass and the endpointing material includes a second substance having a second atomic mass different than the first atomic mass.

65. The substrate of claim 60 wherein the semiconductor material includes first atoms that emit light at a first characteristic wavelength and the endpointing material includes second atoms that emit light at a second characteristic wavelength that is different than the first characteristic wavelength.

66. The substrate of claim 60 wherein the semiconductor material includes first atoms that emit light having a first intensity when impinged by laser radiation at a selected radiation, and the endpointing material includes second atoms that emit light having a second intensity when impinged by the selected laser radiation, the first intensity being different than the second intensity.

67. The substrate of claim 60 wherein the endpointing material includes ionized atoms.

68. An apparatus for detecting the endpoint of a planarizing process of a microelectronic substrate having a first substance and a second substance, the second substance being beneath a surface of the microelectronic substrate, the apparatus comprising:

a planarizing device having a first portion and a second portion movable relative to the first portion to remove material from the microelectronic substrate positioned therebetween, the material including atoms of the first and second substances;

transport means to move the material from the planarizing device; and

a mass spectrometer coupled to the transport means to receive the material and detect the atomic mass of the second substance.

69. The apparatus of claim 68, further comprising a vaporizer having an inlet coupled to the transport means to receive the material, a heat source to vaporize the atoms of the first and second materials and form a vapor, and an outlet coupled to the mass spectrometer.

70. The apparatus of claim 68, further comprising a fluid source in fluid communication with the platen to provide fluid to the platen during planarization of the microelectronic substrate, wherein the transport means includes a conduit

coupled between the platen and the mass spectrometer to move the fluid and the material removed from the microelectronic substrate to the mass spectrometer.

71. The apparatus of claim 68, further comprising a controller operatively coupled to the planarizing device and the mass spectrometer to control motion of the planarizing device upon receiving a control signal from the mass spectrometer.

72. The apparatus of claim 68 wherein the polishing medium includes a polishing pad having abrasive particles that are removed from the polishing pad during planarization, further comprising:

a fluid source in fluid communication with the platen to provide fluid to the platen; and

a filter coupled to the transport means between the platen and the mass spectrometer to remove at least a portion of the abrasive particles from the fluid.

73. An apparatus for detecting the endpoint of a planarizing process of a microelectronic substrate having a first substance and a second substance implanted in the first substance, comprising:

a planarizing device having a first portion and a second portion movable relative to the first portion to remove material from the microelectronic substrate, the material including atoms of the first and second substances;

a source of impinging radiation located proximate to the planarizing device and having an aperture to direct the impinging radiation toward the microelectronic device; and

a detector spaced apart from the microelectronic device to receive emitted radiation emitted by atoms of the microelectronic substrate while the atoms are attached to the microelectronic substrate.

74. The apparatus of claim 73 wherein one of the first and second portions of the planarizing device includes a platen having a polishing pad adjacent thereto and the other of the first and second portions of the planarizing device includes a carrier that releasably engages the microelectronic substrate with the polishing pad, the platen having a first aperture and the polishing pad having a second aperture aligned with the first aperture to transmit the impinging radiation to the microelectronic substrate and transmit the emitted radiation to the radiation detector.

75. The apparatus of claim 74, further comprising a solid transparent material in the aperture.

76. The apparatus of claim 75 wherein the solid transparent material includes a crystal.

77. The apparatus of claim 73, further comprising a controller operatively coupled to the planarizing device and the detector to control motion of the planarizing device upon receiving a control signal from the detector.